Searching for life on Europa

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Extremely cold and bombarded by intense radiation, Jupiter's moon Europa seems like one of the last places in the solar system to look for life. But Europa could hold organic material yet undiscovered and an ocean hiding deep below its thick, frozen crust.

To help NASA with its interplanetary research, Los Alamos National Laboratory is designing a prototype instrument known as OrganiCam, capable of withstanding the extreme conditions on Europa. It is proposed for an upcoming mission to Jupiter's moon with the goal of deepening understanding of this tantalizing world and extending the search for life in the solar system.

History of space exploration

Los Alamos scientists have plenty of history helping NASA explore another world for evidence of habitability and ultimately of life. In the early 2000s the first neutron spectrometer — developed by the Laboratory — orbited Mars, discovering and mapping its vast water resources. More recently they designed ChemCam, a combination of lasers, spectrometers, a telescope, and a camera that piggybacked on the Mars Curiosity rover to study Martian rocks and helped find evidence for a habitable Mars in the past.

The Los Alamos team is now testing SuperCam, a souped-up version of ChemCam set to join the Mars 2020 mission with a camera, laser, spectrometers, and microphone to identify chemicals and minerals on the red planet.

ChemCam, SuperCam and OrganiCam leverage the lab's work in radiation hardening of satellites, space-based detection and development of unique sensors such as those used for global security and nonproliferation.

Identifying possible organic materials

The lab is collaborating with colleagues at the University of Hawaii and in France on OrganiCam, which uses a fluorescence-spectrometer similar in some ways to the one on SuperCam. Researchers are designing OrganiCam to identify possible organic materials on Europa.

Once it arrives after its long journey, the instruments will get straight to work. Its pulsed laser will illuminate a large area and its super-fast camera will make a panorama in search of a nanosecond-brief fluorescence signal, glowing for a fraction of a second under the laser's light.

OrganiCam's spectrometer does two things: first, based on spots identified in panoramic fluorescence images, it detects the unique fluorescence signatures categorizing any organic materials present. If something glows with a nanosecond lifetime, it's probably organic, and if it's organic, it could be bacteria—life.

Next, using Raman spectrometry, it identifies materials by their "fingerprint" spectra. Once glowing targets are identified by OrganiCam, the lander will stretch out its two-meter-long arm, scoop up samples and bring them inside for further analysis. Finally, the lander will send data up to an orbiter, which will relay the information to waiting scientists back on Earth.

> The full version of this story first appeared in the Science on the Hill column in the Santa Fe New Mexican, which highlights Laboratory science.